Fisheries and Oceans Canada | Pêches et Océans Canada
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Canadian Science Advisory Secretariat
Gulf Region | Science Response 2015/015

UPDATED INDICES OF ABUNDANCE TO 2014 FOR STOCKS OF SIX GROUNDFISH SPECIES ASSESSED BY DFO GULF REGION

Context

DFO has conducted research vessel (RV) surveys in the southern Gulf of St. Lawrence, Northwest Atlantic Fisheries Organization (NAFO) Area 4T (Figure 1) using standardized protocols each September since 1971. In addition, two sentinel programs, a sentinel longline program beginning in 1995 and an August otter trawl survey beginning in 2003, have been conducted by DFO in collaboration with the fishing industry. Results of these surveys provide information on trends in abundance and biomass for groundfish species in the 4T area. While these data reflect trends in biomass and abundance and are a critical part of science-based stock assessments, a full assessment, including other sources of data, would be required to evaluate the impacts of management measures on population status. Fisheries and Aquaculture Management (FAM) requested a review of the DFO survey information on the following species in NAFO Area 4T: Atlantic cod, American plaice, white hake, winter flounder, and yellowtail flounder. In addition, information on witch flounder in the 4RST area (northern and southern Gulf of St. Lawrence) was requested by FAM. For this stock, data from RV and sentinel surveys of the southern Gulf were combined with data from similar surveys conducted in the northern Gulf to construct survey indices. A similar update of indices for these species was completed to the year 2013 (DFO 2014). The survey information in this update will be communicated by FAM to the various industry stakeholders for the intervening years of the multi-year management plan. The information may also be used to determine which stocks may benefit from a detailed review in future years. This Science Response Report results from the Science Response Process of February 27 2015, on the review of indicators of status of groundfish stocks (American plaice, white hake, yellowtail, witch, winter flounder) assessed by DFO Gulf Region.

Background

The six species and stocks covered by this report are under commercial fishery moratorium or have small annual Total Allowable Catches (TAC) (Table 1).

The September RV survey of the southern Gulf of St. Lawrence follows a stratified random sampling design (Figure 1), and includes sampling of fish and invertebrates using a bottom otter trawl. This survey, conducted annually since 1971, is the primary data source for monitoring trends in species distribution, abundance, and biological characteristics (e.g., size and age composition, growth) in the southern Gulf of St. Lawrence (for details see Savoie 2014a). The same stratification scheme has been used since 1971, except for the addition of three inshore strata (401-403) in 1984. Unless otherwise stated, the analyses presented here are based on the 24 strata (415-439) sampled since 1971. Comparative fishing experiments were conducted to test for changes in fishing efficiency whenever there was a change in research vessel (1985, 1992, and 2004/2005), trawl gear (1985) or survey protocol (i.e., a change from day only to 24-hr fishing in 1985). When a change in fishing efficiency was detected for a particular species, catch rates of that species were standardized to a constant level of efficiency so that indices remained comparable for the entire time series (Benoît and Swain 2003; Benoît 2006).

Canada

Table 1. Groundfish species and stocks addressed in this report and the total allowable catch in 2014 for each species.

Species and stock	Total allowable catch in 2014
Atlantic cod (*Gadus morhua*) 4T-4Vn(Nov-April)	300 t (no directed commercial fishery)[1]
American plaice (*Hippoglossoides platessoides*) 4T	250 t
White hake (*Urophycis tenuis*) 4T	30 t (no directed commercial fishery)[1]
Winter flounder (*Pseudopleuronectes americanus*) 4T	300 t
Yellowtail flounder (*Limanda ferruginea*) 4T	300 t
Witch flounder (*Glyptocephalus cynoglossus*) 4RST	300 t

[1] to cover by-catch in other groundfish fisheries; a limited recreational fishery, scientific purposes, and negotiated Aboriginal food, social and ceremonial agreements

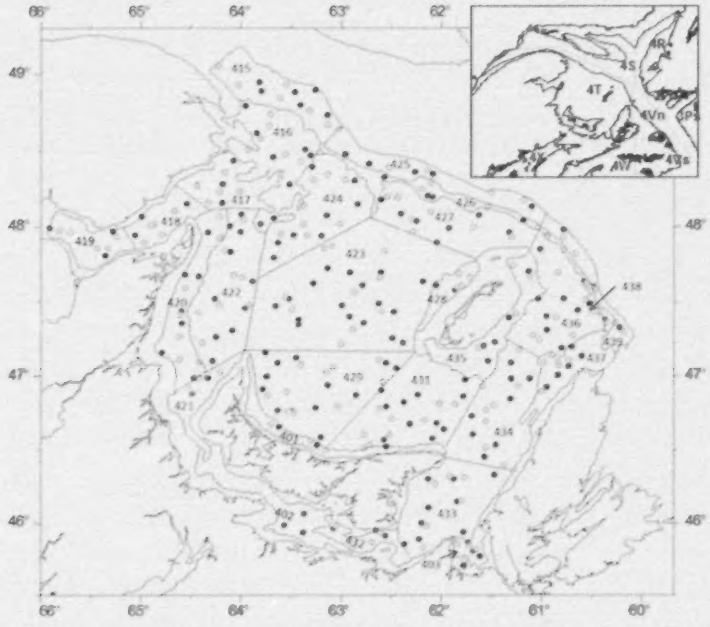

Figure 1. Location of the fishing sets from the September trawl survey (black) and the August sentinel survey (white) in 2014. Inset panel shows the NAFO Divisions 4R, 4S and 4T.

The RV survey was designed to provide abundance trends for fish and invertebrates distributed between depths of about 20 m and 350 m. Survey indices are expected to be proportional to abundance for most species. The distributions of some species, such as winter flounder which is a coastal species, are not fully covered by the survey. Abundance trends for these species may only provide an indication of the direction of change over time.

The sentinel bottom-trawl survey, conducted each August since 2003, uses the same stratified random design as the RV survey (Figure 1). The survey is conducted using four commercial vessels each year, using the same fishing gear and standardized protocols. For widely distributed species (Atlantic cod and American plaice), abundance and biomass indices have been standardized for any differences in fishing efficiency between vessels. This is not possible for species with more restricted distributions. See Savoie (2014b) for further details.

The sentinel longline program for the southern Gulf of St. Lawrence provides an index for cod (Savoie 2014c). Fishing is conducted at fixed sites in near-shore areas distributed throughout the southern Gulf. Each site was fished several times a year in the July – October period. A standardized annual index of catch rates of cod was obtained from 1995 to 2014 using a statistical analysis that accounted for differences in catch rates between months and sites.

Analysis and Response

Indicators of the stock by species

The update of indices for these species to 2013 is provided in DFO (2014).

Atlantic cod

The last full assessment of the Atlantic cod stock in the southern Gulf of St. Lawrence was conducted in February 2009 using data from 2008 and earlier (DFO 2009; Swain et al. 2009). In addition, a Recovery Potential Assessment (RPA) was conducted in February 2011 using data from 2009 and earlier (DFO 2011a; Swain et al. 2012a). Both these analyses led to the conclusion that adult biomass in this stock was at the lowest level observed in the 60-year record and well below the limit reference point (LRP) for this stock, the level below which the stock is considered to have suffered serious harm to its productivity. The directed fishery for southern Gulf cod was closed in 1994-1997, 2003, and since 2009.

The RV survey biomass index (mean weight in kg per tow) for cod of pre-commercial (< 42 cm) lengths was at the lowest level observed in the 44-year time series in 2010-2012 (Figure 2a). The index in 2013 and 2014 was at a higher level, comparable to the levels observed in 2002 and 2009. Uncertainty in the index was high in these years, and the relatively high index in 2009 was not reflected in subsequent increases in biomass at larger sizes.

The RV biomass index for commercial-sized (≥ 42 cm) cod has been at a low level since the early 1990s (Figure 2b). The index declined from the early 2000s to the lowest levels observed in the 44-year time series in 2011 and 2012. The index remained near this record low level in 2014.

The biomass index for cod from the sentinel bottom-trawl survey has declined over the 12-year time series (Figure 3). The 2012 and 2013 values are the lowest in the time series. The index increased in 2014 to the level observed in 2011, but uncertainty in the 2014 index value is high. The 2014 index remains low at about a third of the level at the start of the time series in 2003.

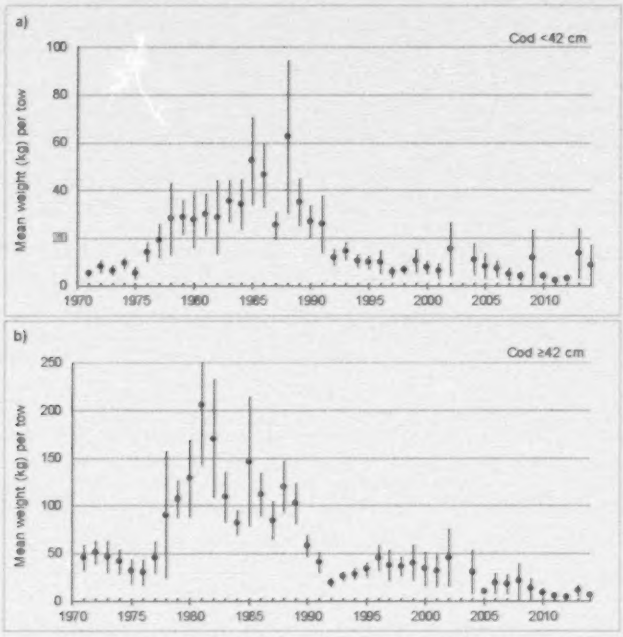

Figure 2. RV survey biomass indices (mean weight in kg per tow) for Atlantic cod of pre-commercial (a) and commercial (b) lengths, 1971 to 2014. These size classes correspond approximately to juvenile and adult cod. Vertical lines denote approximate 95% confidence limits (± 2 standard errors).

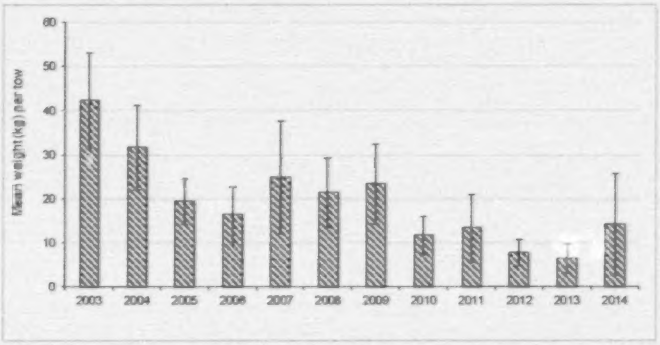

Figure 3. Biomass index (mean weight in kg per tow) for Atlantic cod (all sizes) from the sentinel bottom-trawl survey, 2003 to 2014. Vertical lines denote approximate 95% confidence limits. The indices have been standardized for differences in fishing efficiency between vessels.

The cod biomass index (kg per 1000 hooks) from the sentinel longline program declined each year from 2005 to 2011, setting a new record each year for the lowest level of the time series (Figure 4). The index was at a slightly higher level in 2012 and 2013, but remained near the record low level, and declined again to near record low level in 2014.

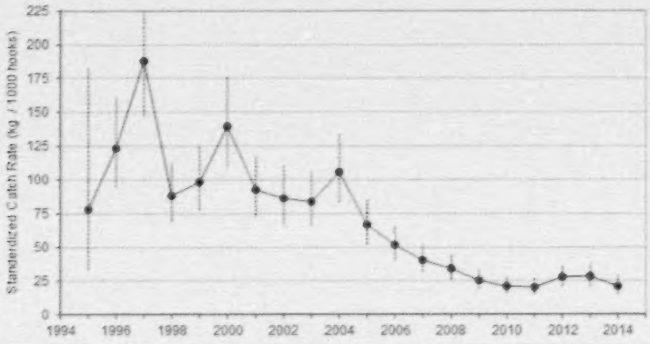

Figure 4. Standardized catch rate (mean kg per 1000 hooks) for Atlantic cod (all sizes) from the sentinel longline program, 1995 to 2014. Vertical lines denote approximate 95% confidence limits.

American plaice

The status of American plaice in the southern Gulf of St. Lawrence was last reviewed in February 2012 as part of a Recovery Potential Assessment and the establishment of the LRP for this stock (DFO 2011b; DFO 2012c; Morin and LeBlanc 2012; Morin et al. 2013).That review, using data to 2011, concluded that the 4T stock of American plaice was at an all-time low level of abundance and had been below the LRP since 1997 (except in 2004).

The RV survey biomass index for pre-commercial sizes (< 30 cm) of American plaice declined steadily from 1991 to 1999 and has remained at a near record low level since then (Figure 5a). The biomass index for commercial sizes (≥ 30 cm) shows the same pattern (Figure 5b).

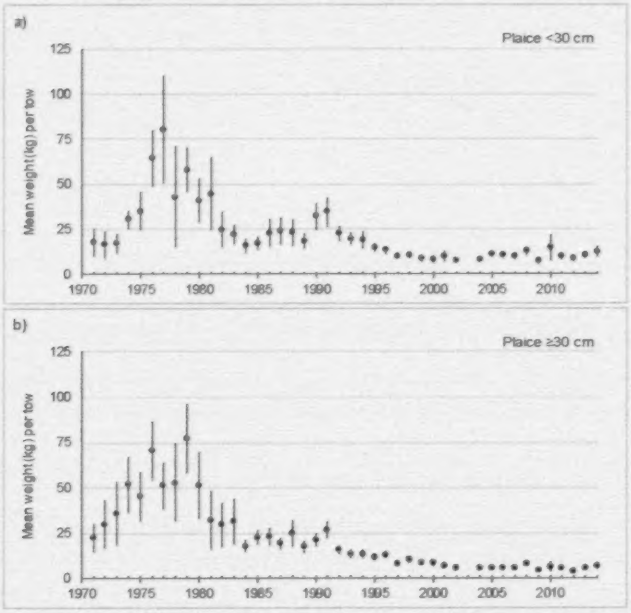

Figure 5. RV survey biomass indices (mean weight in kg per tow) for American plaice of pre-commercial (a) and commercial (b) lengths, 1971 to 2014. Vertical lines denote approximate 95% confidence limits.

The biomass index for plaice from the sentinel bottom-trawl survey has declined since the start of the time series in 2003 (Figure 6). The 2014 value is the lowest in the time series.

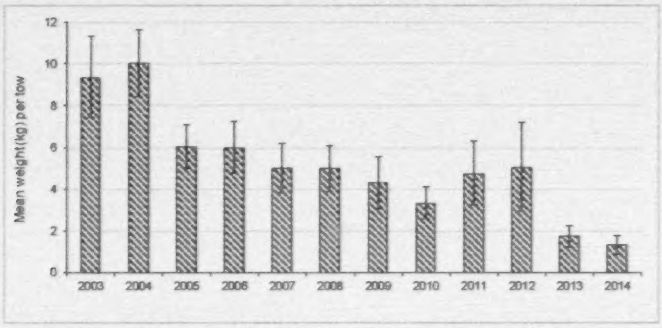

Figure 6. Biomass index (mean weight in kg per tow) for American plaice (all sizes) from the sentinel bottom-trawl survey, 2003 to 2014. Vertical lines denote approximate 95% confidence limits. The indices have been standardized for differences in fishing efficiency between vessels.

White hake

The last full assessment of the 4T white hake stock was conducted in 2001 (DFO 2001; Hurlbut and Poirier 2001). Survey data on this resource were updated to 2002 (DFO 2005a) and in a review of information on the status of this stock (Swain et al. 2012b) in preparation for the assessment of white hake by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The pre-COSEWIC review reported that there had been an 80-90% decline in the abundance of mature fish in this stock over the past three generations (i.e., between 1984 and 2010) and that there had been no recovery of this resource despite a moratorium on the directed fishery since 1995. A Recovery Potential Assessment of the Designatable Unit of white hake in the southern Gulf of St. Lawrence was conducted in January 2015; the advisory report from this assessment is in preparation.

The RV survey biomass index for commercial-sized (≥ 45 cm) white hake declined sharply between the mid-1980s and mid-1990s, and has been at a very low level since then (Figure 7b). The biomass index for pre-commercial (< 45 cm) sizes of white hake has been relatively low in most years since 1993 (Figure 7a), though the decline in the index for these small sizes was not as sharp as the decline at larger sizes. The index in 2013 was at the lowest level observed in the time series. The pre-commercial biomass index was at relatively high levels in 2000, 2007 and 2014, but uncertainty in the index was very high in all three years. The high indices of pre-commercial biomass in 2000 and 2007 were not reflected in increased biomass at commercial sizes in subsequent years.

The white hake biomass index from the sentinel bottom-trawl survey declined from the start of the series to very low levels in 2012 and 2013 (Figure 8). The index in 2014 was about three times the levels in 2012 and 2013. This index is for all sizes and the higher value in 2014 is consistent with the higher value for pre-commercial sizes of white hake noted in the RV survey. Uncertainty in this index is high.

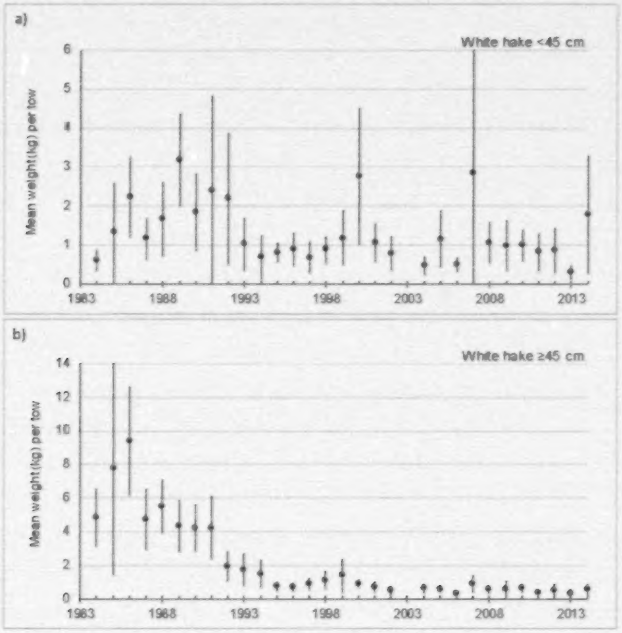

Figure 7. RV survey biomass indices (mean weight in kg per tow) for white hake of pre-commercial (a) and commercial (b) lengths, 1984 to 2014. Vertical lines denote approximate 95% confidence limits. Indices are based on strata 401 and 403 in addition to the standard strata 415-439; hence the indices begin in 1984 instead of 1971.

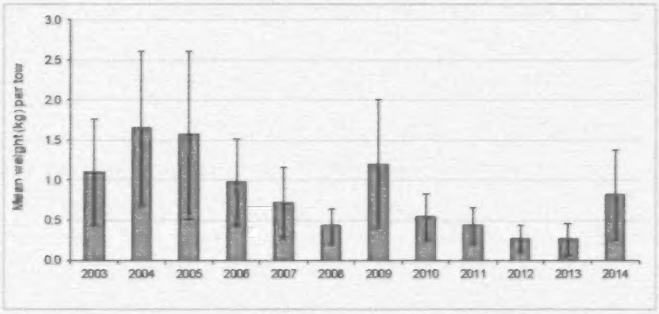

Figure 8. Biomass index (mean weight in kg per tow) for white hake (all sizes) from the sentinel bottom-trawl survey, 2003 to 2014. Vertical lines denote approximate 95% confidence limits. The indices have not been standardized for differences in fishing efficiency between vessels.

Winter flounder

Winter flounder in NAFO area 4T was last assessed in 2012 using data up to 2011 (DFO 2012a; Morin et al. 2012). The 2012 assessment reported that the survey biomass index for winter flounder had declined to the lowest level on record in 2011.

The RV survey biomass index for winter flounder of pre-commercial lengths (< 25 cm) was at an intermediate level from 1993 to 2010 (Figure 9a). This index declined to a low level in 2011 and has remained at that low level since then. The biomass index for commercial sizes (≥ 25 cm) has been in decline since the early 1990s (Figure 9b). The index in 2014 was near the record-low 2012 value.

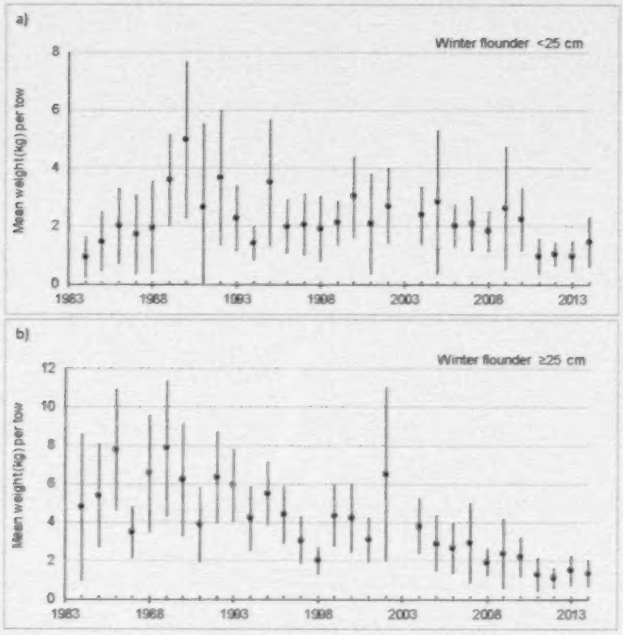

Figure 9. RV survey biomass indices (mean weight in kg per tow) for winter flounder of pre-commercial (< 25 cm; upper panel a) and commercial (≥ 25 cm; lower panel b) lengths. Vertical lines denote approximate 95% confidence limits. Indices are based on strata 401-403 in addition to the standard strata 415-439; hence the indices begin in 1984 instead of 1971.

The biomass index for winter flounder from the sentinel bottom-trawl survey has declined since the start of the survey in 2003 (Figure 10). This index was at the lowest levels of the time series in 2012 to 2014, averaging 5% of the value at the start of the time series.

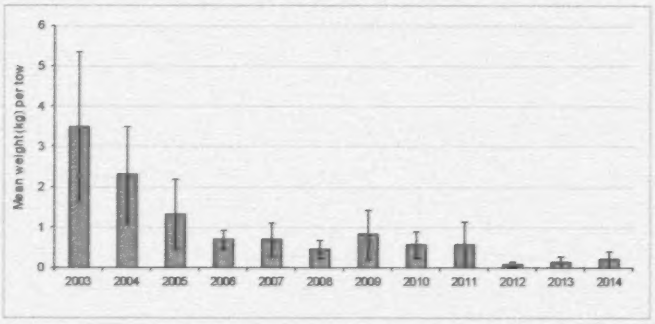

Figure 10. Biomass index (mean weight in kg per tow) for winter flounder (all sizes) from the sentinel bottom-trawl survey, 2003 to 2014. Vertical lines denote approximate 95% confidence limits. The indices have not been standardized for differences in fishing efficiency between vessels.

Yellowtail flounder

The last full assessment of 4T yellowtail flounder was conducted in 2002 and used data from 2001 and earlier (DFO 2002; Poirier and Morin 2002). The RV survey abundance index was reported to have remained relatively stable from 1985 to 2001 over the whole 4T area. In the strata surrounding the Magdalen Islands, where the main fishery for yellowtail occurred, the abundance index increased from 1985 to 1993 and remained relatively stable from 1993 to 2001. A large reported commercial catch of 800 t in 1997 appeared to result in a decline in the

modal size of yellowtail in the RV survey catches. It was suggested that the stock appears able to support harvest levels closer to 300 t. An update was provided in 2005 (DFO 2005b) and a review of size at maturity and size characteristics of the catches in the fishery in the Magdalen Islands was conducted in 2010 (DFO 2010).

The RV survey biomass index for pre-commercial sized (< 25 cm) yellowtail flounder increased greatly from the mid-1980s to the mid-2000s and has remained high since then (Figure 11a). In contrast, the biomass index for commercial-sized (≥ 25 cm) yellowtail decreased sharply from the mid-1990s to 2012. This index increased in 2013 and 2014 but remained near the record-low 2012 level (Figure 11b). The biomass index for yellowtail from the sentinel bottom-trawl survey decreased over the 2003-2014 time series with the value in 2014 the lowest on record (Figure 12).

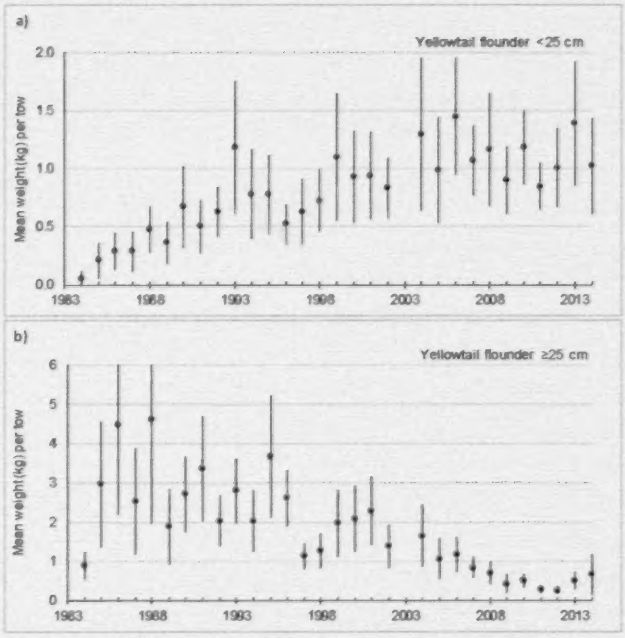

Figure 11. RV survey biomass indices (mean weight in kg per tow) for yellowtail flounder of pre-commercial (< 25 cm; upper panel a) and commercial (≥ 25 cm; lower panel b) lengths, 1984 to 2014. Vertical lines denote approximate 95% confidence limits. Indices are based on strata 401-403 in addition to the standard strata 415-439; hence the indices begin in 1984 instead of 1971.

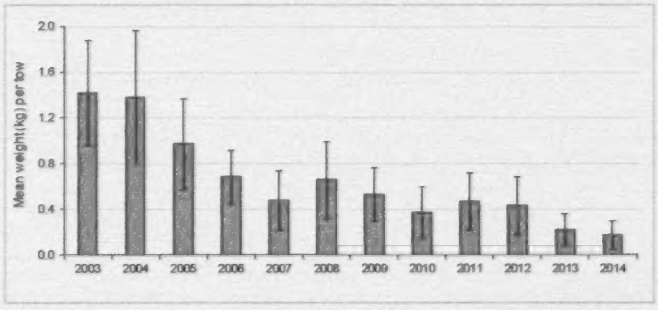

Figure 12. Biomass index (mean weight in kg per tow) for yellowtail flounder (all sizes) from the sentinel bottom-trawl survey, 2003 to 2014. Vertical lines denote approximate 95% confidence limits. The indices have not been standardized for differences in fishing efficiency between vessels.

The main fishery for yellowtail flounder occurs in the waters off the Magdalen Islands. The RV survey biomass indices for yellowtail in the strata surrounding the Magdalen Islands are shown in Figure 13. Like in the 4T area as a whole, biomass at pre-commercial sizes increased sharply from the late 1980s to the mid-2000s in the area around the Magdalen Islands whereas biomass at commercial sizes dropped sharply between the mid-1990s and late 2000s in this area. Commercial biomass has been at the lowest level observed since 2007.

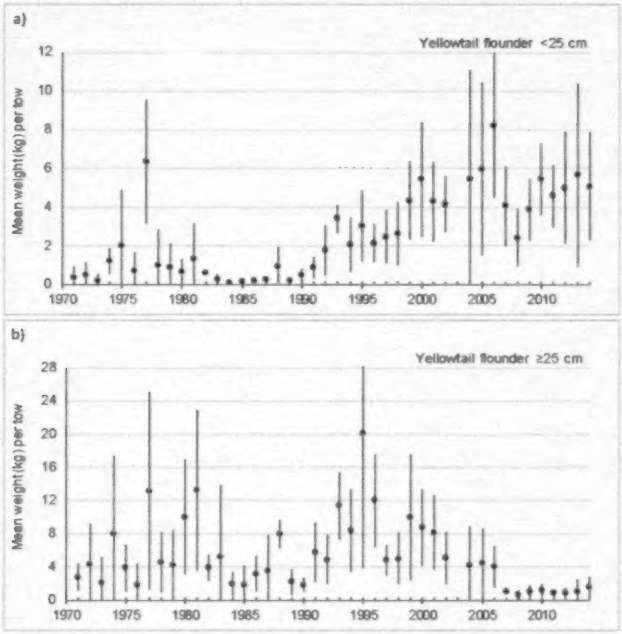

Figure 13. RV survey biomass indices (mean weight in kg per tow) for yellowtail flounder of pre-commercial (< 25 cm; upper panel a) and commercial (≥ 25 cm; lower panel b) lengths in strata 428 and 434 to 436 (the strata surrounding the Magdalen Islands), 1971 to 2014. Vertical lines denote approximate 95% confidence limits.

Witch Flounder

Unlike the other stocks reviewed here, the management unit for witch flounder is NAFO area 4RST, corresponding to the entire Gulf of St. Lawrence. Biomass indices are constructed for this stock by combining data from the September RV survey of the southern Gulf and the August RV survey of the northern Gulf (Swain et al. 2012c). Based on the results of comparative fishing experiments, catch rates are standardized to account for any differences in fishing efficiency between the different vessels and gears that have been used to conduct these surveys. Because some of these adjustments are length dependent, the combined index is available only since 1987, the first year in which length frequency information is available for witch flounder in the August survey. Similarly, a combined sentinel survey index is constructed using data from the August sentinel bottom-trawl survey of the southern Gulf and the July sentinel survey of the northern Gulf. The same gear is used in these two surveys, except that a restrictor cable is used in the July survey but not the August survey. This combined index is available since 2003, the first year that the August sentinel survey was conducted.

The last assessment of the 4RST witch flounder stock was conducted in February 2012 using data to 2011 (DFO 2012b; Swain et al. 2012c,). A population model fit to fishery catch and survey biomass indices indicated a 90% decline in commercial biomass since 1961, with biomass in 2011 estimated to be about half of the LRP. However, survey length distributions

indicated that a strong year-class was approaching commercial sizes and may promote rebuilding of the stock if catches were kept low.

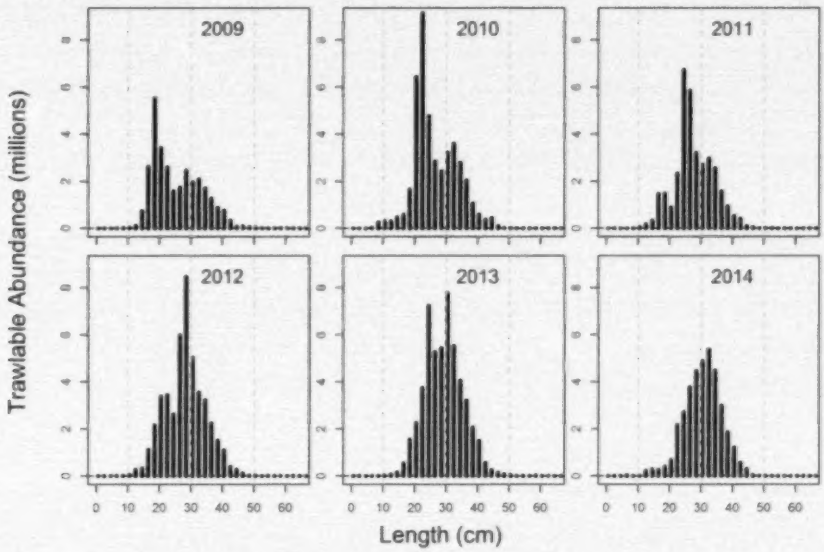

Figure 14. Length distributions of witch flounder in RV survey catches in 2009-2014.

Catches in the 2012 to 2014 RV surveys indicate that the strong year-class observed in the 2009-2011 surveys is now recruiting to commercial sizes (Figure 14). The RV biomass index for commercial sizes (30+ cm) increased since 2011 (Figure 15). This increase was primarily in the 30-40 cm length interval, which is consistent with an increase in biomass due to the recruitment of this strong year-class. A recent increase is also evident in the sentinel biomass index, though this index tends to fluctuate quite widely (Figure 16). The biomass indices for this stock show large inter-annual variations and additional years of data are needed to confirm whether stock biomass is recovering.

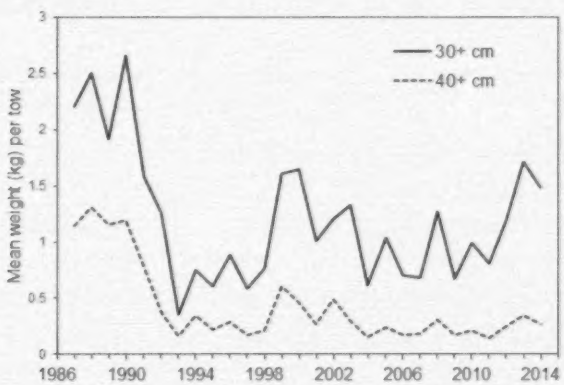

Figure 15. RV biomass index (mean weight in kg per tow) for two size groups of witch flounder, 1986 to 2014.

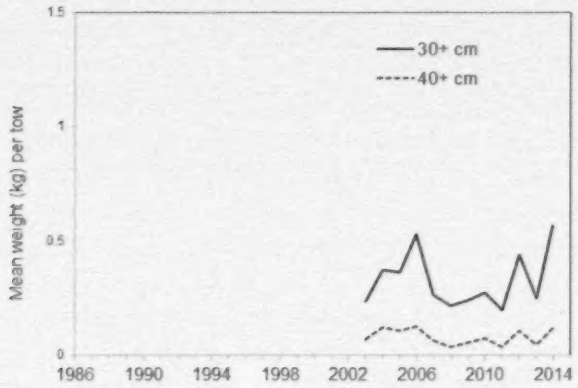

Figure 16. Sentinel survey biomass index (mean weight in kg per tow) for two size groups of witch flounder, 2003 to 2014.

Conclusions

The RV and sentinel biomass indices for commercial sizes of Atlantic cod, American plaice, white hake and winter flounder in recent years indicate that there has been no improvement in biomass for these stocks since their last assessment. In all cases, the indices indicate that commercial biomass remains at record low levels.

In the case of yellowtail flounder, indices of commercial biomass have declined greatly since the last assessment in 2002. These declines have occurred despite relatively high biomass at pre-commercial sizes, suggesting that mortality at commercial sizes must be very high. The decline in commercial biomass was particularly severe in the strata surrounding the Magdalen Islands, where the main fishery for this stock occurs. In this area, the index dropped suddenly to the lowest level on record in 2007 and has remained at that very low level since then.

In the case of witch flounder, there may have been some improvement in biomass since the last assessment, which used data up to 2011. This improvement appears to reflect the recruitment of a strong-year class to commercial sizes. However, indices for this stock show high inter-annual variability and additional years of data are required to substantiate the apparent increase in biomass at commercial sizes.

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Approved by

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Gulf Region
March 11, 2015

Sources of information

This Science Response Report results from the Science Response Process of February 27, 2015, on the review of Indicators of status of groundfish stocks (American plaice, white hake, yellowtail, witch, winter flounder) assessed by DFO Gulf Region. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

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